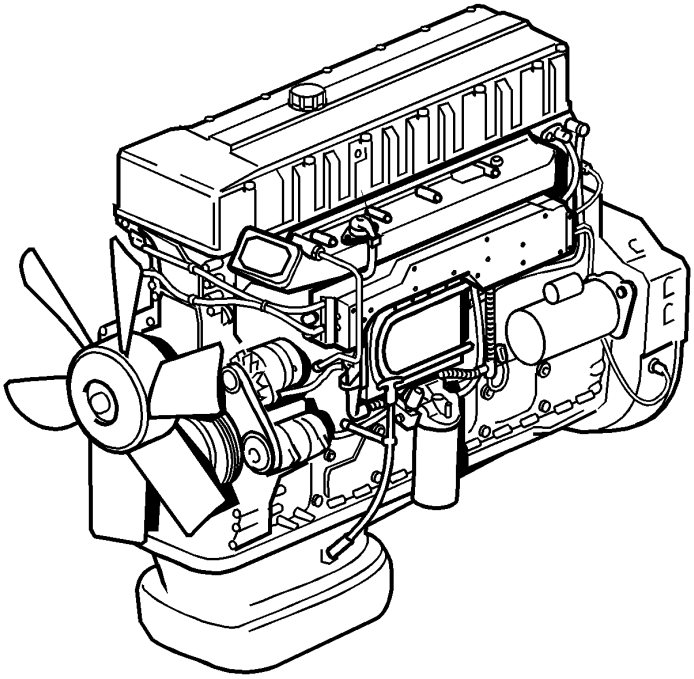
VOLVO
Volvo Trucks North America, Inc.
Greensboro, NC USA

TSI

This TSI Service Bulletin replaces TSI Service Bulletin 215–001, “Camshaft, D12, D12A, D12B” (11.2001), publication no. PV776–TSP160576.

Date	Group	No.	Supp.	Page
8.2003	**215**	**001**		1(21)

Camshaft



W2002653

Fig. 1: VOLVO D12B Engine

This information covers procedures for camshaft repair on VOLVO D12, D12A, and D12B engines.

Contents

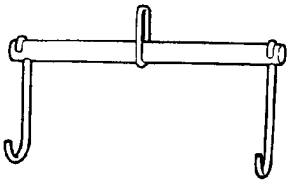
Tools

Special Tools

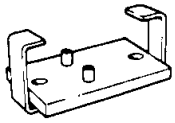
The following special tools are used to replace or repair components. The tools can be ordered from Volvo. Please use the specified part number when ordering.

9996956
Flywheel Turning Tool

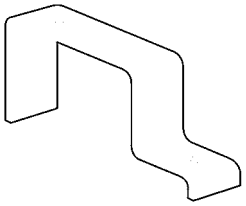
9998255
Rocker Arm Bridge Lifting Tool



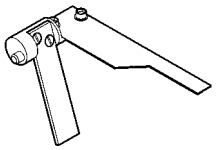
9998264
Camshaft Removal Tool



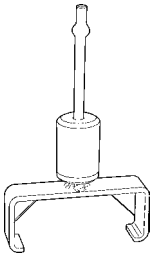
9998270
Counterhold



J-41272
Front Cover Tool



J-42773
Camshaft Alignment Tool



J-44457
Camshaft Bearing Cap Removal Tool

9996950
Flywheel Stop Tool

Service Procedures

2154-03-02-01
Camshaft, Replacement

(With EPG or VEB)

You must read and understand the precautions and guidelines in Service Information, Group 20, "General Safety Practices, Engine" before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

CAUTION

Observe the greatest possible cleanliness when working on the cylinder head. Dirt particles in the fuel and oil channels can cause the unit injectors to malfunction, and can cause the VEB (if equipped) to fail.

Special tools: 9996956, 9998255, 9998264, 9998270, J-44457

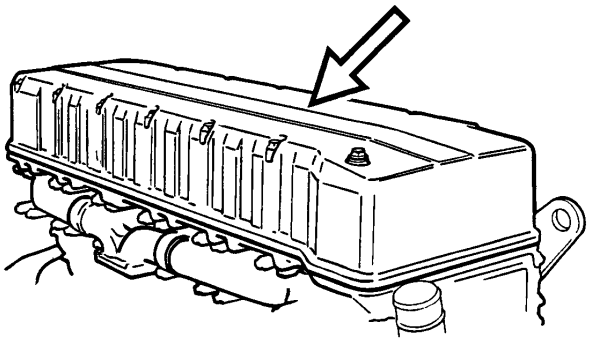
Removal

1

WARNING

Use a hoist or get assistance when lifting components that weigh 23 kg (50 lb.) or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. Always use a spreader bar when necessary. The lifting hooks MUST NOT be side loaded. Failure to follow these warnings may result in personal injury.

Remove the valve cover (valve cover should be removed from the exhaust side of the engine).



T2006731

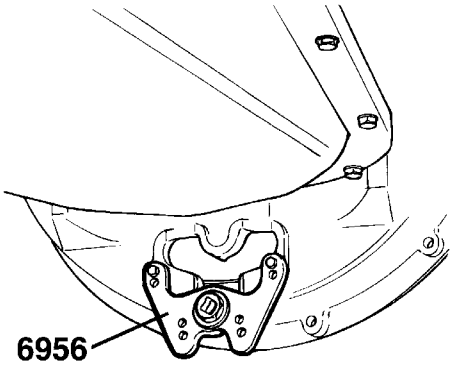
Fig. 2: Valve cover

Note: On WIA, bring the valve cover towards the radiator to remove. On WG, it is necessary to remove the engine cover (doghouse).

Note: Be careful that the stud bolts do not loosen. Otherwise, the unit injector wiring harness can be damaged.

2

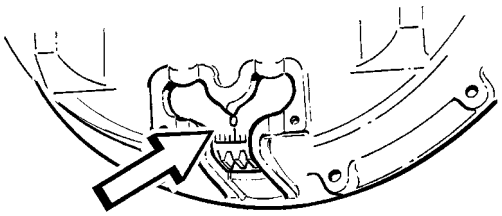
Disconnect the connector for the electrical wires on the upper timing gear cover. Remove the clamp and the cover.



T2006672

3
Remove the upper timing gear cover.

4



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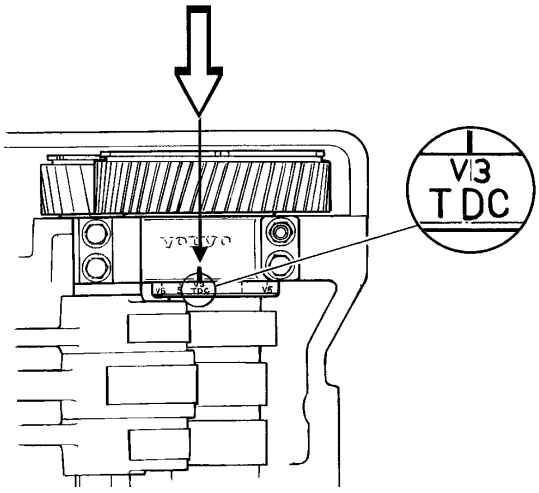
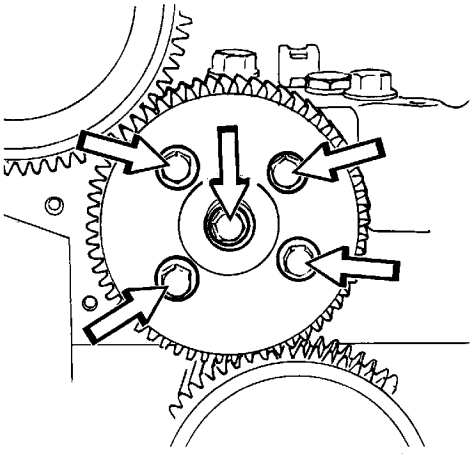
Remove the inspection cover from underneath the flywheel housing and install turning tool 9996956.

9996956



T2008250

5
Turn the flywheel around until the piston in cylinder number 1 is in the Top Dead Center position (0°) on the flywheel and the camshaft marking (TDC) is opposite the marking on the bearing cap.

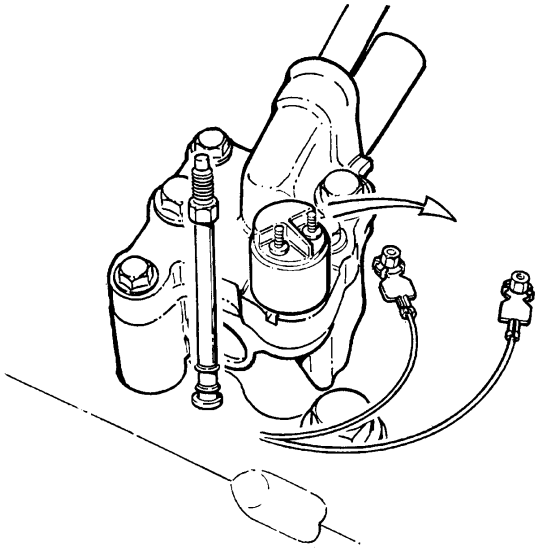


T2007095

Fig. 3: Bolts holding the idler gear in place

6

Remove the adjustable idler gear.



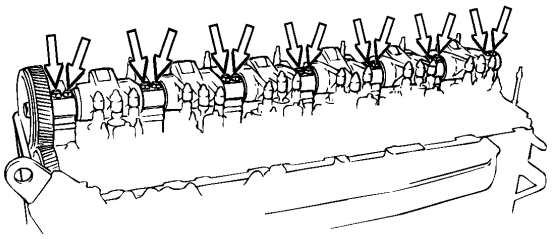
T2008812

7

If the engine is equipped with VEB, remove the control valve and pipe. Plug the ports and place it in a plastic bag to avoid it being subjected to dirt and contamination. To facilitate removal, remove the valve cover stud bolt.

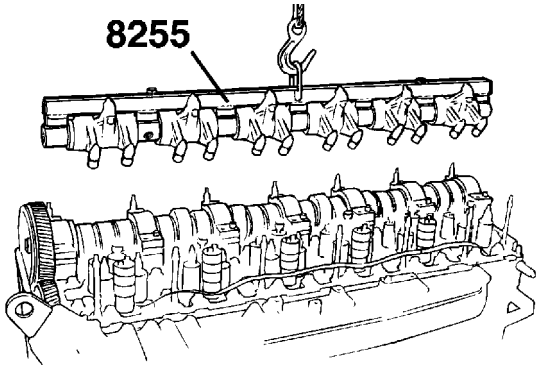
Note: Failure to remove the control valve before removing the rocker arm shaft assembly may result in damage to the control valve and/or the pipe.

8



T2006777

Fig. 4: Removing the rocker arm shaft assembly bolts



W2000937

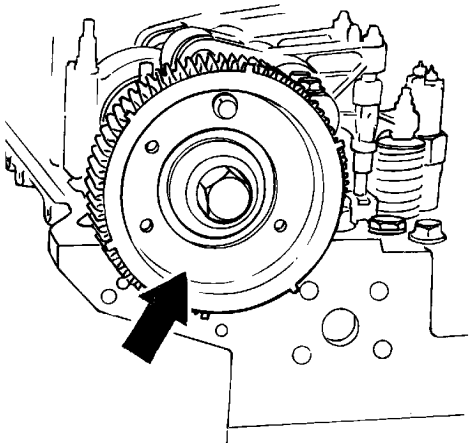
Fig. 5: Removing the rocker arm shaft assembly

Loosen the rocker arm shaft bolts gradually to avoid bending the arm shaft assembly. Remove the bolts, install tool 9998255 and lift off the rocker arm shaft assembly.

Note: On engines equipped with VEB, wrap a rubber band around each exhaust rocker lever and slave piston. This is to prevent the VEB slave pistons from falling out of their rocker arm bore.

9998255

9



T2007096

Fig. 6: Cam sensor wheel

Remove the cam sensor wheel from the camshaft drive gear.

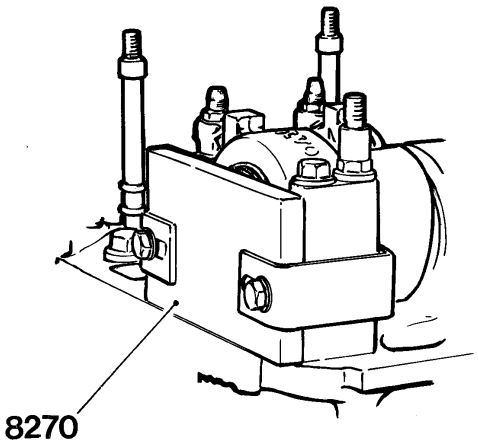


Fig. 7: Tool 9998270 installed

10

Install camshaft counterhold tool 9998270 on the rear of the camshaft. Loosen and remove the camshaft drive gear center bolt and the cam gear.

9998270

11

Remove the camshaft cap bolts. Mark the caps for the respective bearing housings, and remove.

Note: To facilitate the removal of the camshaft bearing caps, use tool J–44457.

Note: Failure to match the correct camshaft cap with the respective bearing housing will cause engine damage.

J–44457

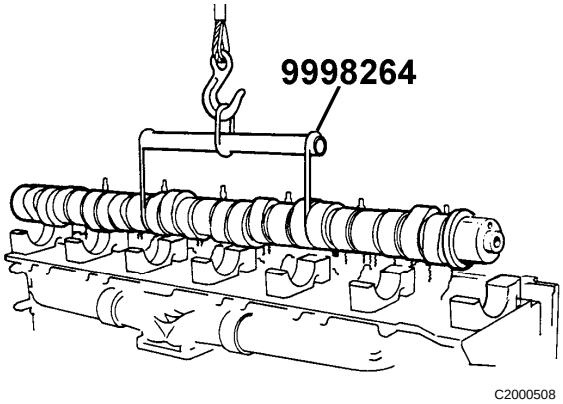


Fig. 8: Lifting the camshaft

12

Carefully lift off the camshaft using tool 9998264.

9998264

13

Remove the bearing shells from the bearing housings.

14

Inspect the bearings and housings for damage.

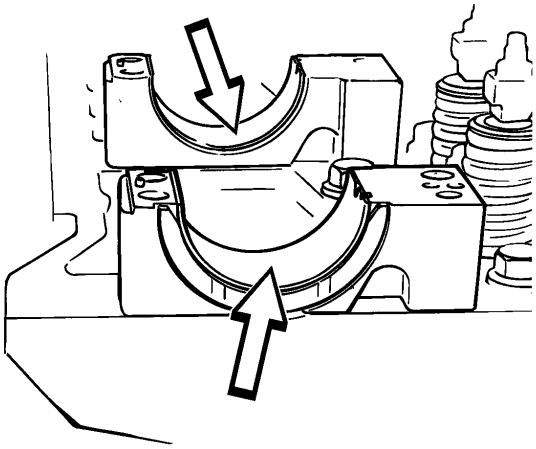
Note: When replacing the camshaft on the D12 engine, remember that the bearing shells are available in different sizes. Refer to Group 20, Specifications.

Installation

15
Position the camshaft bearing housings on the cylinder head by observing the factory marks 1–7.

Note: Check that the mating surface is clean under the bearing housings and that the guide pins are in good condition. If installing a new cylinder head, also use the bearing housings supplied with the cylinder head.

16



T2007126

Fig. 9: Bearing shell halves

Coat the bearing shell halves with clean engine oil and install them in the bearing housings. Carefully lower the camshaft into place.

Note: Make sure that bearing shells of the correct size are installed and correctly positioned in the bearing housing.

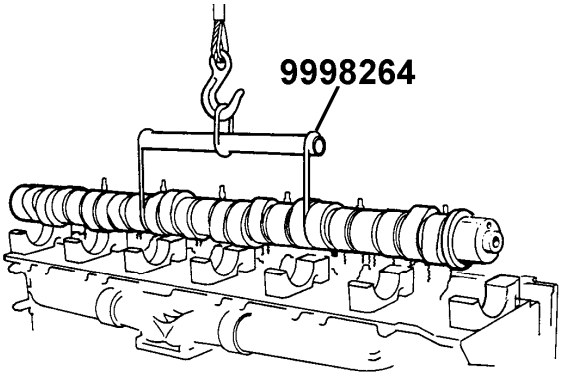


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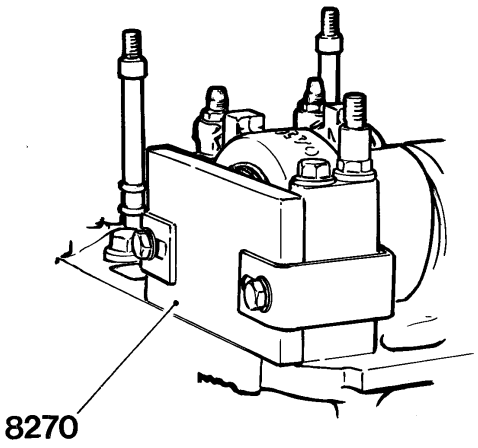
Fig. 10: Installing the camshaft

17
Coat the bearing shell halves with clean engine oil and install them in the camshaft caps. Install the caps on their respective bearing housings. Hand-tighten the bolts.



T2007148

Fig. 11: Installing the camshaft drive gear

18

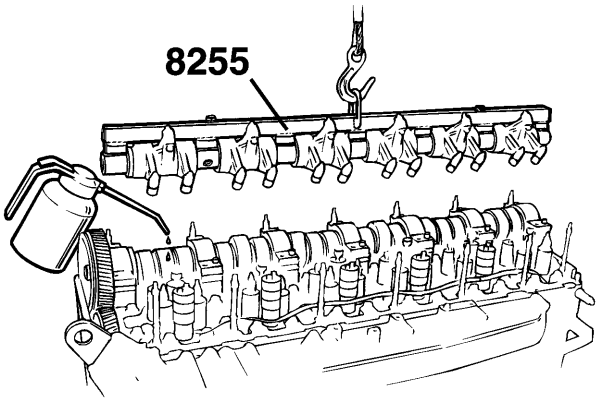
Install the camshaft drive gear. Use tool 9998270 to lock the camshaft into place. Torque-tighten to 645 ± 25 Nm (475 ± 18 ft-lb).

Note: Do NOT install the bolts for the rocker arm shaft.

645 ± 25 Nm
(475 ± 18 ft-lb)
9998270

19

Adjust the camshaft timing; refer to “Camshaft Timing, Check and Adjust” page 18.



T2006820

Fig. 12: Installing the rocker arm bridge

20

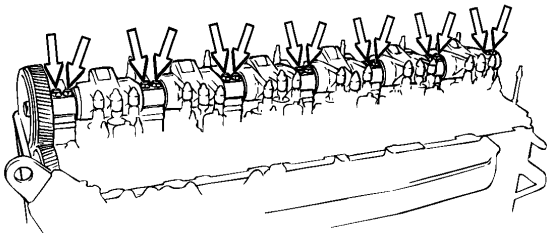
Apply clean engine oil to the valve bridges and camshaft lobes. Using tool 9998255, lift the rocker arm shaft assembly into place. Make sure that the valve bridges and the rocker arms are correctly positioned in relation to each other.

9998255

21

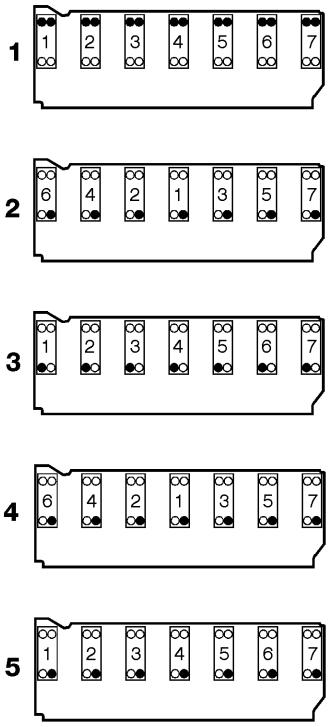
Hand-tighten the rocker arm shaft with the bolts until it bottoms against the bearing housings.

Note: Tighten the rocker arm shaft bolts gradually so that no distortions occur on the shaft. Do **NOT** torque.



T2006777

Fig. 13: Tightening rocker arm shaft and camshaft together



W2003520

Fig. 14: Bearing caps and camshaft/rocker shaft, tightening sequence

22

Tighten the rocker arm shaft **together** with the camshaft, using the 5-step sequence and torques shown:

D12, D12A, D12B:

1 15 ± 5 Nm (11 ± 4 ft-lb); +90 ± 5°
2 45 Nm (33 ft-lb)
3 15 ± 5 Nm (11 ± 4 ft-lb); +90 ± 5°
4 45 Nm (33 ft-lb); loosen to 0 Nm (0 ft-lb)
5 15 ± 5 Nm (11 ± 4 ft-lb); +90 ± 5°

When reinstalling a rocker arm shaft that has been loosened or removed, torque only the bolts that hold the rocker arm shaft.

23

Note: (Engines with VEB:) Reinstall the VEB control valve Reconnect sliding valve and pipe into the rocker arm shaft as a unit. Apply Loctite to threads and torque tighten the bolts to 33 ± 4 Nm (24 ± 3 ft-lb).

33 ± 4 Nm
(24 ± 3 ft-lb)

24

Install the cam sensor wheel and mounting bolts. Turn the cam sensor wheel clockwise (as viewed from the front of the engine) against the mounting bolts; torque bolts to 25 Nm (19 ft-lb).

25 Nm
(19 ft-lb)

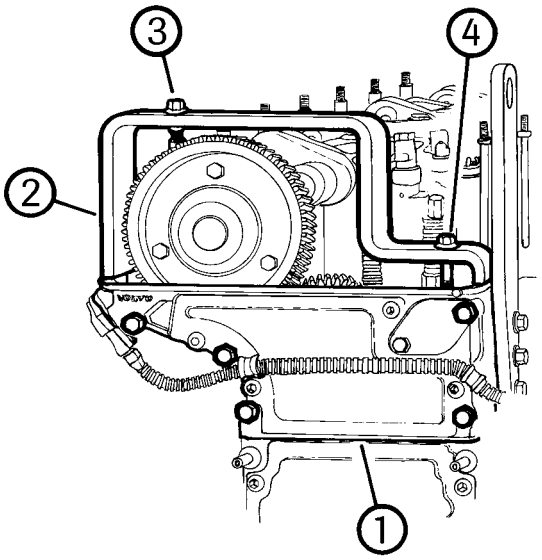
25
Clean the contact surfaces for the upper timing gear cover. Install a new rubber seal.

26
Apply an even bead of sealant around the timing gear cover. Install the cover.

> **CAUTION**
>
> Do not allow sealant to harden before installing the cover. The bolts must be torque-tightened within 20 minutes.

27
Install the alignment tool J–41272 on the forward right-hand valve cover stud using an existing valve cover nut. To attach the left-hand side, thread the bolt (supplied with the tool) into the hole in the cylinder head. The top of the cover must be flush with the top of the cylinder head. Otherwise, oil leaks may result.

J–41272



W2002163

Fig. 15: Installing alignment tool J–41272

1 Upper gear cover
2 Alignment tool
3 Valve cover nut
4 Bolt supplied with J–41272

28
Draw the cover down evenly until the cylinder head and cover are aligned. Tighten cover mounting bolts in the proper sequence and torque to 33 ± 3 Nm (24 ± 3 ft-lb).

33 ± 3 Nm
(24 ± 3 ft-lb)

29
Rotate the camshaft until the cam sensor wheel tooth aligns with the cam sensor. Verify that the air gap is between 0.3 – 0.7 mm (0.012 – 0.028 in.). Adjust if needed by removing or adding shims between the sensor and the cover. Relocate the timing cover, before the sealant hardens, if necessary to aid in obtaining the proper air gap.

Note: Make sure the air gap is between 0.3 – 0.7 mm (0.011 – 0.028 in.).

0.3 – 0.7 mm
(0.012 – 0.028 in.)

30
Connect the electrical cable to the cam sensor on the cover.

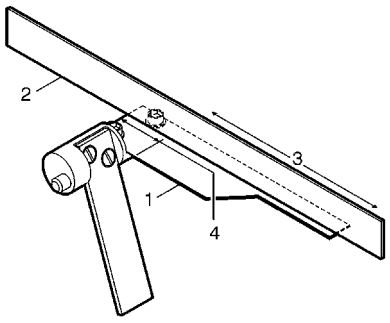
31
After installing the camshaft, adjust the valves and unit injectors; refer to Service Information, Group 21.

2154-06-03-01
Camshaft Timing, Checking

(See also “Camshaft Timing, Check and Adjust” page 18.)

You must read and understand the precautions and guidelines in Service Information, Group 20, "General Safety Practices, Engine" before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Note: Before using the cam gear timing tool J-42773, always make sure that the pointer is straight. To check the straightness (refer to numbers in accompanying illustration):



W0002186

- Hold the tool with the pointer horizontal (1).
- Place a straight edge 90 degrees to the pointer along its entire length (2).
- If light can be seen between the straight edge and the pointer, bend the pointer and recheck for straightness (3).

- Use the portion of the pointer that is fastened to the tool shaft as a reference surface since this part is protected from being bent (4).

Special tools: 9996956, J–41272, J–42773

1
Steam clean around the valve cover and the upper front cover.

2
Disconnect the negative battery lead.

3
VN model only
Drain coolant and then remove the top right fan ring support and the top radiator neck from the thermostat housing.
All other models
Remove the fan ring support bracket, remove the fan belt and then remove the fan, the fan hub and bracket as one assembly. Relocate in the fan shroud area while making sure not to damage the radiator.

4
Remove the intake pipe that spans from the air filter to the turbo and then cover the turbo.

5
Remove the valve cover.

6
Remove the VEB and cam sensor harness connections to the upper front cover.

7
Disconnect the internal wiring harness to the VEB control solenoid.

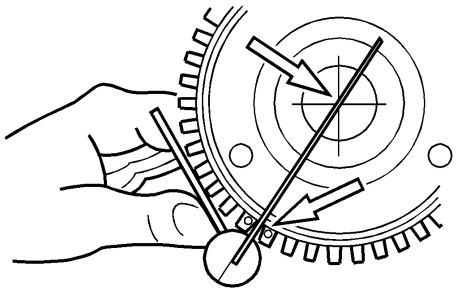
8
Remove the upper front cover.

9
Slightly loosen the cam sensor wheel and note the position of the wheel in relation to its mounting bolts, i.e. clockwise against the mounting bolts, in the center, or counter-clockwise against the mounting bolts.

10
Remove the cam sensor wheel.

11
Remove the inspection cover on the flywheel housing. Install the engine turning tool 9996956.

9996956

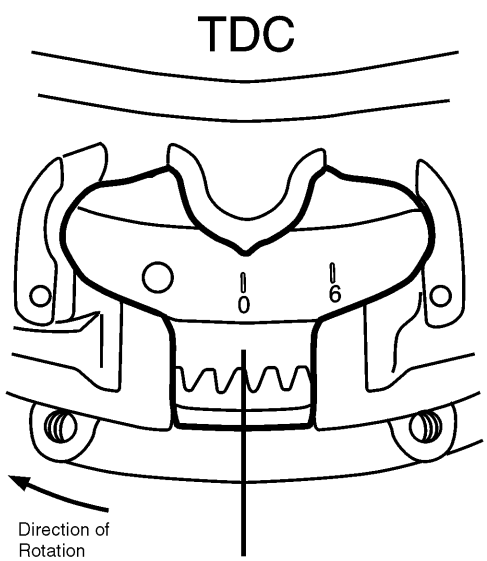


T2012262

Fig. 16: Installing camshaft alignment tool

12
Install camshaft alignment tool J–42773 by inserting the guide pin into the hole under the camshaft drive gear. Rotate the tool to position the lever against the drive gear teeth to ensure that the tool is positioned correctly. Rotate engine in the direction of rotation until the 2 dots on the camshaft gear are equally spaced on both sides of the camshaft alignment tool.

J–42773



W2004266

Fig. 17: Flywheel direction of rotation

13
Assure that the 0° mark aligns with the flywheel pointer.

14
Re-assemble
Install the cam sensor wheel and mounting bolts. Turn the cam sensor wheel clockwise (as viewed from the front of the engine) against the mounting bolts; torque bolts to 25 Nm (19 ft-lb).

25 Nm
(19 ft-lb)

15
Clean all sealant from the upper front cover.

16
Apply a bead of silicone sealant around the upper cover along with a new rubber gasket.

17
Position the upper front cover and install the mounting bolts; hand tighten only.

18
Install the front cover positioning tool, J–41272. Tighten bolts to align front cover. Torque the cover mounting bolts to 33 ± 4 Nm (24 ± 3 ft-lb). Verify that the cover is flush with the head.

Note: Tighten positioning tool, J-41272 until upper front cover is flush with cylinder head on both sides.

J–41272
33 ± 4 Nm
(24 ± 3 ft-lb)

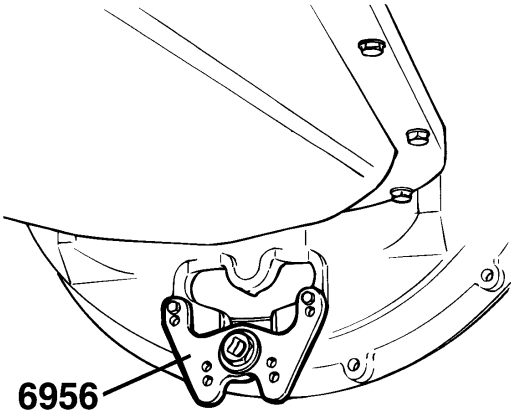
19
Remove tool, J–41272.

Note: Remove any sealant that gets on the cam sensor wheel to prevent any sensor signal faults.

20
Rotate the camshaft until the cam sensor wheel tooth aligns with the cam sensor. Verify that the air gap is between 0.3 – 0.7 mm (0.012 – 0.028 in.). Adjust if needed by removing or adding shims between the sensor and the cover. Relocate the timing cover, before the sealant hardens, if necessary to aid in obtaining the proper air gap.

21
Remove the engine turning tool and reinstall the cover.

9996956



T2006672

22
Install the VEB solenoid harness and torque nuts to 1.4 Nm (1 ft-lb). Fasten all clips. Connect the external harness to the front cover.

1.4 Nm
(1 ft-lb)

23
Clean the valve cover and gasket contact surface.

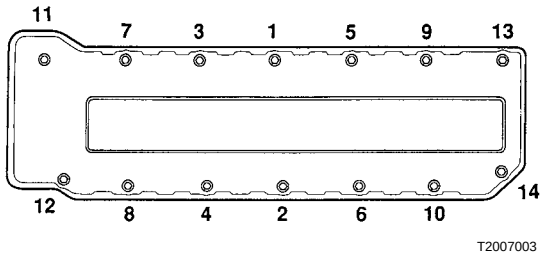


Fig. 18: Valve cover tightening sequence

24
Install the valve cover and torque-tighten the bolts to specifications using the proper sequence (see Fig. 18: Valve cover tightening sequence, page 16).

Note: Tighten the valve cover nuts according to the proper sequence and torque. This is to prevent the valve cover from cracking and also to keep the studs in the cylinder head from loosening. If any of the valve cover stud bolts loosened from the cylinder head when the nuts were removed, the cable harness for the unit injectors should be checked. There is a risk that the cable holder on the stud bolt may have followed with the rotation of the bolt and possibly damaged the cable harness.

Engine Serial Number	Torque
Below 25748	20 ± 2 Nm (15 ± 1 ft-lb)
Above 25748	30 ± 3 Nm (22 ± 2 ft-lb)

25
Install the intake piping.

26
Reassemble depending on the model.

27
Connect negative battery cable.

WARNING

Always wear safety glasses when working around batteries. Failure to do so could result in serious personal injury.

28
Steam clean the engine, around the valve cover, timing cover, and transmission bellhousing.

29
Check for any active fault codes and clear any inactive fault codes.

30
Run the engine until the coolant reaches operating temperature. Allow to idle for approximately 10 minutes for cylinder balancing. For cylinder balancing to take place, the following conditions must be satisfied:

- Idling speed must be below 650 RPM.
- Fuel requirement must be below a specific rating.
- Idling adjustment function must not be active.
- Constant engine speed mode (PTO) not active.
- Cruise control mode not active.
- Accelerator pedal in idling position (0%).
- Coolant temperature must be above 50 °C (122 °F).
- Vehicle must be at a standstill (vehicle speed sensor value of 0).
- No fault codes present.

31
Check for leaks.

2154-06-03-02
Camshaft Timing, Check and Adjust

You must read and understand the precautions and guidelines in Service Information, Group 20, "General Safety Practices, Engine" before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

CAUTION

Failure to properly set the camshaft timing to the crankshaft may result in loss of performance, poor fuel economy, or in extreme cases, engine damage.

Special tools: 9996956, J–41272, J–42773

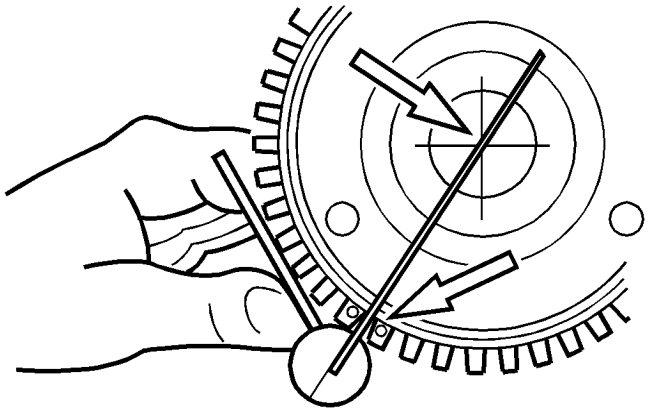
1
Install the camshaft alignment tool J–42773 by inserting the guide pin into the hole under the camshaft drive gear. Rotate the tool to position the lever against the drive gear teeth to ensure correct positioning of the camshaft alignment tool.

J–42773

2
Position the camshaft using the flywheel turning tool 9996956.

Note: The camshaft setting must be exactly as illustrated in the figure. It is important that the camshaft gear marking is positioned precisely on both sides of the tool in a line extending from the center of the camshaft.

9996956



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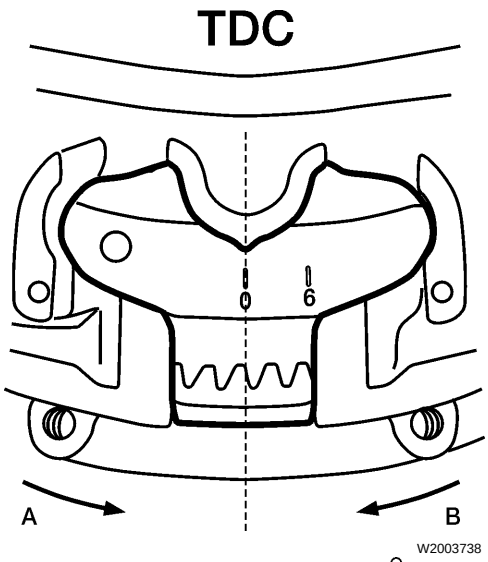


Fig. 19: Rotating the flywheel to 0° TDC

A Opposite direction of engine rotation
B Direction of engine rotation

3
Using flywheel turning tool 9996956, turn the flywheel opposite to the direction of engine rotation (A) approximately 15° BTDC. Then turn the flywheel in direction of engine rotation (B) until the 0° mark on the flywheel lines up exactly with the pointer on the flywheel housing without passing the 0° mark.

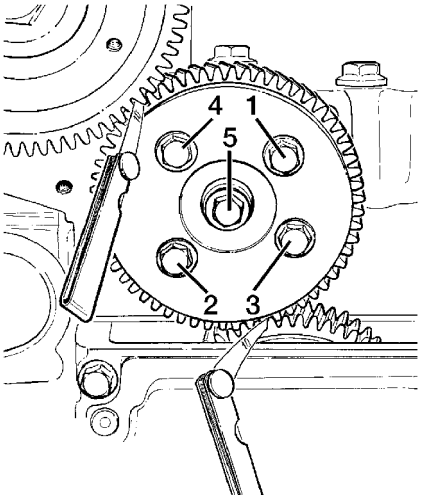
CAUTION

If the flywheel is turned past 0° TDC, repeat the above step, completely. Do not just back up the flywheel. Turning the flywheel in the opposite direction of normal rotation will result in an incorrect setting due to improper gear train lash.

4
Clean all sealant from the front of the head.

5
Install the adjustable idler gear assembly.

Note: The bolts are the single-use “stretch” type and should not be reused. Pipe sealant should be used on the center bolt.



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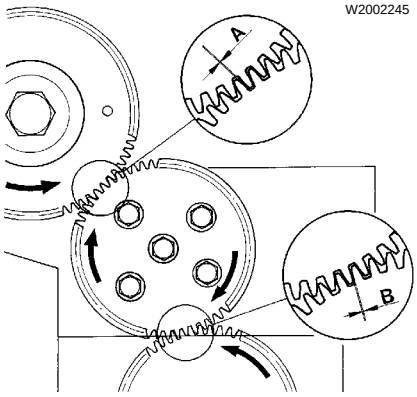
6



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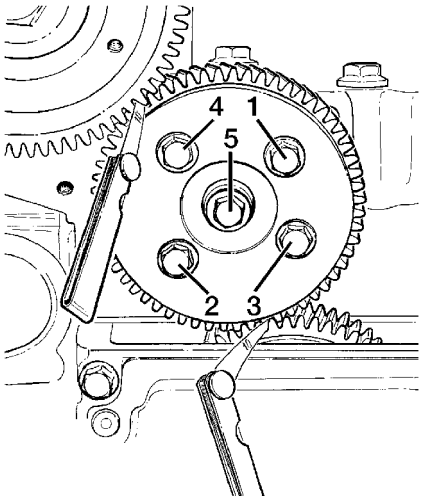
Insert two 0.10 mm (0.004 in.) feeler gauges on the load sides of the (A and B) gear.

7
Torque the bolts to an initial torque of 5 ± 3 Nm (11 ± 2 ft-lb).

Note: An additional 120 ± 5° is required after the correct backlash is confirmed.

15 ± 3 Nm
(11 ± 2 ft-lb)

8
Check that both feeler gauges have the same resistance when inserting them and pulling them out. The correct backlash is 0.05 - 0.17 mm (0.002 - 0.007 in.).



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9
Tighten the bolts an additional 120 ± 5° per the torque sequence shown.

10
Re-check camshaft timing; refer to “Camshaft Timing, Checking” page 12. For information on valve adjustment and injector installation, also refer to Service Information, Group 21.